Economic Study of Cotton Production and Marketing in Egypt
(Case study: Dakahlia Governorate)

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***Abstract*:** Egyptian cotton occupies a prominent position in the Egyptian national economy as it is an important and primary source of currency and foreign exchange for the country. Due to its global position among various global cottons, it is characterized by quality, spinning qualities, and staple length that are not available in many other global varieties. Egyptian cotton has gone through many internal and external turns and challenges. The main problem of the research is the decline and decrease in both the cultivated area and the total production of the cotton crop. Therefore, the research aims primarily to study and estimate the productive and economic efficiency and the most important production and marketing problems of the cotton crop in Dakahlia Governorate for the 2024 season. The research relied on descriptive and quantitative statistical analysis methods and the use of simple regression analysis to estimate production functions and on secondary data issued by the competent official authorities. In addition, the primary data was obtained through a questionnaire form that was collected through a personal interview with a simple random sample of cotton farmers in Dakahlia Governorate for the 2024 season. The research reached several results, the most important of which is that the cultivated area and total production of cotton crops at the level of the Republic and Dakahlia Governorate took a general trend of statistically significant decrease during the period (2000-2023). It also showed an increase in production costs, as the total costs in Sherbin and Belqas districts amounted to about 41.32 and 38.64 thousand pounds. The productivity per feddan decreased, as it amounted to about 2.84 and 3.27 quintals, respectively. This led to a decrease in total return, as it amounted to about 34.08 and 39.24 thousand pounds, respectively, and the realization of losses in Sherbin district estimated at 7.24 thousand pounds, and a low net return of about 598 pounds in Belqas district. By estimating the partial elasticities of the production elements that were proven to be significant in the districts of Sherbin and Belqas. It was found that they were positive and greater than one, which means that the cotton farmers in the study sample are producing in the first production stage of the law of diminishing returns and that the farmers have not yet reached the optimal production and they had the opportunity to achieve this if the available resources were optimally exploited. It was also shown that the average productivity of the production elements used in Sherbin Center for each of human labor, seeds, phosphate fertilizer, foliar fertilizer, and pesticides amounted to about 0.04, 0.11, 0.12, 0.26, and 0.52 quintals. While the marginal product of the same elements used amounted to about 0.02, 0.-0.38, 0.17, 0.34, and 0.63, respectively. By comparing the value of the marginal product of these elements with their unit price. It was shown that the economic efficiency of these production elements amounted to about 1.13, -72.67, 64.33, 15.71, and 16.97, and all of these values are greater than one, which means that the economic efficiency of using these resources is low and that they have not reached the level of economic efficiency. It is recommended to increase the quantities used in the production process to reach the optimal resource combination, except for the seed element, which is characterized by waste. As for Belqas Center, the average productivity of the production elements used for each of the seeds, foliar fertilizer, pesticides, and mechanical labor amounted to about 0.13, 0.36, 0.45, and 0.08 quintals. While the marginal product of the same elements used amounted to about 0.16, 0.21, 0.05, and -0.04 respectively. By comparing the value of the marginal product of these elements with their unit price, it was found that the economic efficiency of these production elements amounted to about 29.78, 24.21, 1.54, and -2.88. All of these values are greater than one, which means that the economic efficiency of using these resources is low and that they have not reached the level of economic efficiency. It is recommended to increase the quantities used in the production process to reach the optimal resource combination, except for the mechanical labor element, which is characterized by waste. It also becomes clear that by studying the production and economic efficiency of the production elements used to produce the cotton crop at the level of the study sample in Dakahlia Governorate. Some of these elements may achieve production efficiency, but all of them do not achieve economic efficiency. This is due to either the lack of use of some of them or the excessive use of others. This means that the farmers of the research sample cannot reach the optimal resource combination that achieves optimal production. This may be due to the existence of production and marketing problems that have resulted in a decline and decrease in productivity per acre and the achievement of low returns or losses. The most important production problems, according to farmers' opinions, are the weak productivity of current varieties and their inability to withstand the negative effects of climate change. The spread of many insect, fungal, and viral diseases and the ineffectiveness of many pesticides to combat them. The lack of adequate control over fertilizer and pesticide production companies, allows them to manipulate and cheat. The absence of a guidance role to provide advice and correct information to

combat insect and fungal diseases. In addition to marketing problems, represented by the fact that the guaranteed prices set by the state are not done through a realistic study of the production and costs of the cotton crop. There is manipulation within a single auction and a quasi-agreement between companies not to raise prices above a certain limit. There is a large difference in auction prices at the beginning of the season from prices at the end of the season, which harms farmers. In addition, the delay in receiving the value of cotton from banks because of companies' failure to pay on the required date.

Keywords: Cotton, Production, Marketing, Net Return, Farm Price.

I. INTRODUCTION

Egyptian cotton has occupied a prominent position in the Egyptian national economy since Muhammad Ali decided 1805 to introduce cotton to Egyptian lands. It also enjoys a global position among the various world cotton due to its distinguished quality, spinning qualities, and staple length Egyptian cotton has undergone many internal and external challenges and turns during the past years. That is not available in many other world varieties. Therefore, it occupies a prominent position in the list of export crops and is an important and primary source of providing currency and foreign exchange for the country. Egyptian cotton has remained a fundamental pillar of the national economy and even of the social structure and Egyptian family over an extended period. Since Egyptian cotton is not only an agricultural crop but rather an integrated industry that combines agricultural production and industrial production, many local industries are based on its main products, such as the ginning, spinning, weaving, and ready-made clothing industries, and secondary products, such as the production of vegetable oils, soap, and animal feed. In addition, it is considered one of the labor-intensive industries, whether during the production or manufacturing stages. Starting with the economic transformation and lifting the state's hand from economic activities according to the economic reform program. Opening the way for the private sector to invest in the cotton industry in all its production stages of ginning, spinning, weaving, and ending with export. In addition, the global shift in consumer tastes towards blended products of lower quality and cost led to a shift in global demand for the production of short-staple cotton, which led to a decline in global demand for long-staple cotton and a reduction in the quota for Egyptian cotton in the global market [(1)]. This situation was reflected in the Egyptian spinning and weaving factories, which in turn relied on imported short-staple cotton rather than Egyptian long-staple cotton to produce a low-cost product. This ultimately led to a decrease in the cultivated area from about 993 thousand feddan in 1990 to about 518 thousand feddan in 2000, and then the decline in the area continued to about 255 thousand feddan in 2023. Which led to a decrease in local production from 4 million quintals in 1990 to about 1.8 million quintals in 2023 [(8)]. The state is trying to overcome the obstacles and problems facing closed factories and work to open them again. In addition, work to establish new factories with modern technology through a development plan to advance the spinning and weaving industry, estimated to cost about 56 billion pounds, to be carried out in three stages. Moreover, ending the conflict of specializations and technical opinions between the Egyptian Cotton Improvement Fund and the Cotton Research Institute affiliated with the Agricultural Research Center. This is in line with the state's plan to develop and improve the performance system of its affiliated entities, implement the comprehensive administrative reform plan, and restructure some of the entities affiliated with the Ministry of Agriculture and Land Reclamation to enable them to perform their responsibilities most completely. During the 2024 season, the Egyptian government set a guaranteed price of 10,000 pounds per quintal of Upper Egypt cotton and 12,000 pounds per quintal of Lower Egypt cotton, but private sector companies refused to enter the auctions, which forced the Cotton Holding Company to enter the auctions and purchase cotton on its account. However, the guaranteed price announced by the government was not satisfactory to the farmer and was not sufficient to cover his agricultural expenses and costs due to the high rents and costs of production requirements, in addition to the decline and decrease in productivity this year.

Research problem:

The main problem of the research is a decrease in the cultivated area of the cotton crop from about 518 thousand feddan in 2000 to about 255 thousand feddan in 2023, with a decrease rate of about 51%, and the fluctuation and instability of productivity per feddan. This led to a d decrease in the total production of cotton crops from about 3.52 million metric quintals in 2000 to about 1.8 million metric quintals in 2023, with a decrease rate of about 49%. In addition to the production, problems represented by the decrease in productivity per feddan this season the presence of some fungal and insect diseases, and the negative effects of climate change in addition to the marketing problems that occurred in recent years.

Research objective:

The research mainly aims to study and estimate the productive and economic efficiency of the cotton crop, the most important factors affecting production, and the most important production and marketing problems facing cotton production and marketing in Dakahlia Governorate in the 2024 season.

This is achieved through a set of sub-objectives, which are:

First: Studying the status of the area, productivity per feddan, and cotton production in Egypt and Dakahlia Governorate.
Second: Studying the most important items of costs per feddan for cotton production in the study sample in Dakahlia Governorate for the 2024 season.
Third: Studying the productive and economic efficiency of the cotton crop for the study sample in Dakahlia Governorate for the 2024 season.
Fourth: The relative importance of the production and marketing problems facing cotton producers in the study sample in Dakahlia Governorate for the 2024 season.

II. Methodology

To achieve the research objective, descriptive and quantitative statistical analysis methods were applied as simple statistical methods such as percentages and arithmetic averages related to cotton crop production through time series data during the period (2000-2023). In addition to using the simple regression analysis method to estimate the general time trend, the (T-Test) method, and regression analysis to estimate the production functions, to analyze and present the most important results. To achieve its objectives, the research relied on both published and unpublished secondary data issued by the relevant official authorities. In addition to the primary data obtained through a questionnaire form collected through a personal interview with a simple random sample estimated at 120 cotton farmers during the 2024 season in Dakahlia Governorate in the districts of Belqas and Sherbin, as they are the two largest districts in terms of the area planted with cotton. The area of each of them reached about 20.7 and 6.8 thousand feddan, representing about 48.4% and 15.8% respectively of the total cotton crop area at the level of Dakahlia Governorate, which amounts to about 42.7 thousand feddan. The sample was distributed to the affiliated districts and villages, with 70 farms in the Belqas district and 50 farms in the Sherbin district. They were distributed to the villages within the districts according to the geometric average estimates. They also selected randomly from the service register of the agricultural cooperatives affiliated with those villages through personal interviews with the farmers.

III. Results and Discussion

First: The status of the area, productivity per feddan and cotton production in Egypt and Dakahlia Governorate:

A. The status of the area, productivity per feddan and cotton production in Egypt:

(1) The area planted with cotton in Egypt:

Data from Table (1) indicate that the average area planted with cotton crops in Egypt during the period (2000-2023) amounted to about 401 thousand feddan. The minimum area planted with cotton in Egypt was about 131.8 thousand feddan in 2016, representing about 32.9% of the average area planted with cotton in Egypt during the study period. The maximum area planted with cotton in Egypt was about 731.1 thousand feddan in 2001, representing about 182.3% of the average area planted with cotton in Egypt during the study period.

By studying the general time trend of the development of the area planted with cotton crops in Egypt during the period (2000-2023), Equation No. (1) Table (2) shows a general decreasing trend that is statistically significant at a significance level of 1% in the area of cotton crops in Egypt, estimated at 21.12 thousand feddan. With an annual decrease rate of about 5.27% of the yearly average of the area planted with cotton in Egypt, which amounted to about 401 thousand feddan during the study period. The coefficient of determination also shows that about 67% of the changes occurring in the cotton crop area in Egypt are attributed to variables whose effect reflects the time factor.

(2) The productivity per feddan of cotton crop in Egypt:

Data in Table (1) also indicate that the average productivity of feddan of the cotton crop in Egypt reached about 6.8 metric quintals/feddan during the study period. The minimum productivity of feddan of the cotton crop in Egypt reached about 4.2 metric quintals/feddan in 2015, representing about 61.7% of the average productivity of a feddan of cotton crop in Egypt during the study period. The maximum productivity of feddan of the cotton crop in Egypt reached about 8.2 metric quintals/feddan in 2021 and 2022, representing about 119.2% and 119.6% of the average productivity of feddan of the cotton crop in Egypt during the study period.

By studying the general time trend of developing the per-feddan productivity of the cotton, crop in Egypt during the period (2000-2023), Equation No. (2) Table (2) shows a general statistically significant increasing trend at a significance level of 5% in the per-feddan productivity of the cotton crop in Egypt estimated at 0.05 metric quintals/feddan. With an annual increase rate of about 0.74% of the annual average productivity per

feddan of cotton crop in Egypt, which amounted to about 6.8 metric quintals/feddan during the study period. The coefficient of determination also shows that about 30% of the changes in the productivity of the cotton crop per feddan in Egypt are attributed to variables whose effect reflects the time factor.

Table No. (1) Development of the cultivated area, productivity per feddan, and production of cotton crops in Egypt during the period (2000-2023).

years	area		productivity per feddan		production	
	by thousand feddan	%	by Quintals/ feddan	%	by thousand metric quintals	%
2000	**518.3**	**129.3**	**6.8**	**99.1**	**3516.7**	**128.1**
2001	**731.1**	**182.3**	**7.2**	**105.7**	**5284.2**	**192.5**
2002	**706.4**	**176.2**	**6.9**	**100.2**	**4836.2**	**176.2**
2003	**535.1**	**133.4**	**7.0**	**102.9**	**3767.2**	**137.2**
2004	**714.7**	**178.2**	**7.0**	**101.9**	**4985.2**	**181.6**
2005	**656.6**	**163.7**	**6.2**	**90.9**	**4086.0**	**148.9**
2006	**536.4**	**133.8**	**7.1**	**103.8**	**3809.3**	**138.8**
2007	**574.6**	**143.3**	**6.9**	**100.3**	**3940.1**	**143.6**
2008	**312.7**	**78.0**	**6.5**	**94.5**	**2020.2**	**73.6**
2009	**284.4**	**70.9**	**6.3**	**91.8**	**1785.3**	**65.0**
2010	**369.1**	**92.1**	**6.5**	**94.9**	**2397.0**	**87.3**
2011	**520.1**	**129.7**	**7.8**	**113.3**	**4029.6**	**146.8**
2012	**333.4**	**83.1**	**5.6**	**81.7**	**1864.9**	**67.9**
2013	**286.7**	**71.5**	**5.6**	**81.7**	**1603.2**	**58.4**
2014	**369.2**	**92.1**	**5.3**	**77.3**	**1954.7**	**71.2**
2015	**240.9**	**60.1**	**4.2**	**61.7**	**1017.4**	**37.1**
2016	**131.8**	**32.9**	**7.0**	**101.9**	**917.9**	**33.4**
2017	**217.0**	**54.1**	**7.6**	**110.5**	**1639.9**	**59.7**
2018	**336.0**	**83.8**	**8.1**	**118.1**	**2705.0**	**98.6**
2019	**239.4**	**59.7**	**7.5**	**109.4**	**1790.2**	**65.2**
2020	**183.1**	**45.7**	**7.9**	**116.1**	**1452.8**	**52.9**
2021	**237.7**	**59.3**	**8.2**	**119.2**	**1936.5**	**70.6**
2022	**334.5**	**83.4**	**8.2**	**119.6**	**2734.8**	**99.6**
2023	**255.0**	**63.6**	**7.1**	**103.2**	**1800.0**	**65.6**
Average	**401.0**	**100.0**	**6.8**	**100.0**	**2744.8**	**100.0**

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Bulletin of Agricultural Statistics, Part Two, Summer & Nili Corps, various issues.

Table (2) Equations of the general time trend for the area, productivity and production of cotton crop in Egypt during the period (2000-2023).

series	Variable	The equation	Amount of change	Average	Annual Relative Rate of Change %	R^2	F
1	**Cotton area in Egypt** (in thousand feddan)	Y_{1i} =665.04-21.12X_i (14.79)** (-6.713)**	**-21.12**	**401**	**-5.27**	**0.67**	**(45.06)****
2	**Cotton productivity per feddan in Egypt** (quintals/feddan)	Y_{2i} =7.56 - 0.23X_i+0.011X^2_i (13.17)**(-2.188)* (2.603)*	**0.05**	**6.8**	**0.74**	**0.30**	**(4.38)***
3	**Cotton production in Egypt** (in thousand metric quintals)	Y_{3i} =4457.37 -137.01X_i (11.75)** (-5.16)**	**-137.01**	**2744.8**	**-4.99**	**0.55**	**(26.61)****

Y_{1i} = Estimated area of cotton crop in Egypt (in thousand Feddan) in observation i. Y_{2i} = Estimated acre productivity of cotton crop in Egypt (in metric quintals/Feddan) in observation i. Y_{3i} = Estimated production of cotton crop in Egypt (in thousand metric quintals) in observation i, X represents time in years i = 1:24.

** Significant at 0.01 significance level * Significant at 0.05 significance level.

Source: Results of statistical analysis of data in Table (1) using the statistical program (SPSS 20).

(3) Cotton crop production in Egypt:

Data in Table (1) indicate that the average cotton crop production in Egypt amounted to about 2744.8 thousand metric quintals during the study period. The minimum cotton production in Egypt amounted to about 917.9 thousand metric quintals in 2016, representing about 33.4% of the average cotton production in Egypt during the study period. While the maximum cotton production in Egypt reached about 5284.2 thousand metric quintals in 2001, representing about 192.5% of the average cotton production in Egypt during the study period, due to the increase in the area planted with cotton in Egypt in 2001.

By studying the general time trend of the development of cotton production in Egypt during the period (2000-2023), Equation No. (3) Table (2) shows a general trend of a statistically significant decrease at a significance level of 1% in cotton production in Egypt, estimated at 137.01 thousand metric quintals during the indicated period. With an annual decrease rate of about 4.99% of the yearly average of cotton production in Egypt, which amounted to about 2744.8 thousand metric quintals during the study period. The coefficient of determination also shows that about 55% of the changes in cotton production in Egypt are attributed to variables whose effect reflects the time factor.

B. The status of the area, productivity per feddan and cotton production in Dakahlia Governorate:

(1) The area planted with cotton in Dakahlia Governorate:

Data from Table (3) indicate that the average area planted with cotton in Dakahlia Governorate during the period (2000-2023) amounted to about 52.2 thousand feddan, representing about 13.9% of the average area planted with cotton in Egypt.

The minimum area planted with cotton in Dakahlia Governorate was about 31.4 thousand feddan in 2015, representing about 60.2% of the average area planted with cotton in Dakahlia Governorate during the study period. It represents about 13% of the total area planted with cotton in Egypt for the same year. The minimum relative importance of the area planted with cotton in Dakahlia Governorate compared to the area planted with cotton in Egypt was about 9.8% in 2003.

The maximum area planted with cotton in Dakahlia Governorate reached about 89.7 thousand feddan in 2001, representing about 171.8% of the average area planted with cotton in Dakahlia Governorate during the study period, and representing about 12.3% of the total area planted with cotton in Egypt for the same year. The maximum relative importance of the area planted with cotton in Dakahlia Governorate compared to the area planted with cotton in Egypt reached about 19.3% in 2021.

By studying the general time trend of the development of the area planted with cotton in Dakahlia Governorate during the period (2000-2023), Equation No. (1) Table (4) shows a general statistically significant decreasing trend at a significance level of 1% in the area of cotton crop in Dakahlia Governorate, estimated at 1.62 thousand feddan. With an annual decrease rate of about 3.1% of the annual average of the area planted with cotton in Dakahlia Governorate. Which amounted to about 52.22 thousand feddan during the study period. The coefficient of determination also shows that about 44% of the changes occurring in the cotton crop area in Dakahlia Governorate are attributed to variables whose effect reflects the time factor.

(2) The productivity per feddan of cotton crop in Dakahlia Governorate:

Data from Table (3) indicate that the average productivity of feddan of cotton crops in Dakahlia Governorate during the period (2000-2023) amounted to about 7.5 metric quintals/feddan, representing about 108.9% of the average productivity of feddan of cotton crops in Egypt.

The minimum productivity of feddan of cotton crop in Dakahlia Governorate reached about four metric quintals/feddan in 2015, representing about 53.2% of the average productivity of feddan of cotton crop in Dakahlia Governorate during the study period, and representing about 94.8% of the productivity of an acre of cotton crop in Egypt for the same year. The minimum relative importance of the productivity of feddan of cotton crop in Dakahlia Governorate compared to the productivity of feddan of cotton crop in Egypt reached about 76.5% in 2000.

While the maximum productivity of feddan of cotton crop in Dakahlia Governorate reached about 9.9 metric quintals/feddan in 2020, representing about 131.3% of the average productivity of feddan of cotton crop in Dakahlia Governorate during the study period, and representing about 124.4% of the productivity of feddan. The maximum relative importance of the productivity of the cotton crop feddan in Dakahlia Governorate compared to the productivity of the cotton crop feddan in Egypt reached about 132% in 2016.

By studying the general time trend of the development of the per-feddan productivity of the cotton, crop in Dakahlia Governorate during the period (2000-2023), Equation No. (1) Table (4) shows a general statistically significant statistically significant increasing trend at a significance level of 5% in the per-feddan productivity of the cotton crop in Dakahlia Governorate estimated at 0.13 metric quintals/feddan. With an annual increase rate of

about 1.73% of the annual average productivity per feddan of cotton crop in Dakahlia Governorate, which amounted to about 7.5 metric quintals/feddan during the study period. The coefficient of determination also shows that about 24% of the changes in the productivity of the cotton crop per feddan in Dakahlia Governorate are attributed to variables whose effect reflects the time factor.

Table No. (3) Development of the cultivated area, productivity per feddan, and production of cotton crops in Dakahlia Governorate during the period (2000-2023).

Years	area			productivity per feddan			production		
	by thousand feddan	% of period average	% of total Egypt	by Quintals/ feddan	% of period average	% of total Egypt	by thousand metric quintals	% of period average	% of total Egypt
2000	**58.7**	**112.5**	**11.3**	**5.2**	**69.0**	**76.5**	**305.0**	**78.6**	**8.7**
2001	**89.7**	**171.8**	**12.3**	**6.1**	**81.6**	**84.9**	**550.7**	**141.8**	**10.4**
2002	**76.7**	**146.9**	**10.9**	**6.2**	**81.7**	**89.8**	**471.7**	**121.5**	**9.8**
2003	**52.2**	**99.9**	**9.8**	**7.0**	**93.0**	**99.4**	**365.3**	**94.1**	**9.7**
2004	**79.4**	**152.1**	**11.1**	**7.4**	**97.8**	**105.6**	**584.2**	**150.5**	**11.7**
2005	**71.8**	**137.4**	**10.9**	**6.3**	**84.3**	**101.9**	**455.2**	**117.2**	**11.1**
2006	**62.9**	**120.4**	**11.7**	**8.8**	**116.6**	**123.5**	**551.1**	**141.9**	**14.5**
2007	**71.7**	**137.4**	**12.5**	**7.5**	**99.5**	**109.2**	**537.2**	**138.4**	**13.6**
2008	**44.9**	**86.1**	**14.4**	**8.5**	**112.7**	**131.3**	**381.1**	**98.2**	**18.9**
2009	**43.4**	**83.2**	**15.3**	**6.5**	**86.4**	**103.5**	**282.2**	**72.7**	**15.8**
2010	**53.5**	**102.4**	**14.5**	**8.2**	**109.3**	**126.7**	**439.4**	**113.2**	**18.3**
2011	**65.5**	**125.5**	**12.6**	**9.4**	**124.8**	**121.2**	**615.2**	**158.4**	**15.3**
2012	**40.9**	**78.4**	**12.3**	**5.8**	**76.4**	**102.9**	**235.1**	**60.6**	**12.6**
2013	**38.1**	**72.9**	**13.3**	**4.6**	**61.1**	**82.3**	**175.3**	**45.1**	**10.9**
2014	**48.1**	**92.2**	**13.0**	**4.4**	**58.6**	**83.4**	**212.3**	**54.7**	**10.9**
2015	**31.4**	**60.2**	**13.0**	**4.0**	**53.2**	**94.8**	**125.6**	**32.4**	**12.3**
2016	**19.6**	**37.5**	**14.9**	**9.2**	**122.3**	**132.0**	**180.1**	**46.4**	**19.6**
2017	**31.5**	**60.4**	**14.5**	**9.2**	**122.3**	**121.7**	**290.1**	**74.7**	**17.7**
2018	**51.9**	**99.3**	**15.4**	**9.6**	**127.1**	**118.3**	**495.9**	**127.7**	**18.3**
2019	**40.0**	**76.6**	**16.7**	**9.0**	**119.6**	**120.3**	**359.6**	**92.6**	**20.1**
2020	**33.8**	**64.7**	**18.4**	**9.9**	**131.3**	**124.4**	**333.7**	**86.0**	**23.0**
2021	**45.9**	**87.8**	**19.3**	**9.8**	**130.8**	**120.7**	**451.4**	**116.3**	**23.3**
2022	**59.0**	**113.0**	**17.6**	**9.1**	**120.7**	**111.0**	**535.4**	**137.9**	**19.6**
2023	**42.7**	**81.7**	**16.7**	**9.0**	**120.0**	**127.9**	**385.0**	**99.2**	**21.4**
Average	**52.2**	**100**	**13.9**	**7.5**	**100**	**108.9**	**388.2**	**100.0**	**15.3**

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Bulletin of Agricultural Statistics, Part Two, Summer & Nili Corps, various issues**.**

Table (4) Equations of the general time trend for the area, productivity and production of cotton crop in Dakahlia Governorate during the period (2000-2023)

series	Variable	The equation	Amount of change	Average	Annual Relative Rate of Change %	R^2	F
1	**Cotton area in Dakahlia Governorate** (in thousand feddan)	$Y_{4i} = 72.42 - 1.62X_i$ $(12.9)^{**}$ $(-4.11)^{**}$	**-1.62**	**52.22**	**-3.10**	**0.44**	$(16.92)^{**}$
2	**Cotton productivity per feddan in Dakahlia Governorate** (quintals/feddan)	$Y_{5i} = 5.91 + 0.13X_i$ $(8.45)^{**}$ $(2.65)^{*}$	**0.13**	**7.5**	**1.73**	**0.24**	$(7.03)^{*}$
3	**Cotton production in Dakahlia Governorate** (in thousand metric quintals)	$Y_{6i} = 339.34 + 65.4X_i - 8.31X^2_i + 0.247X^3_i$ $(2.92)^{**}$ 1.656 $(-2.29)^{*}$ $(2.59)^{*}$	**-29.85**	**388.2**	**-7.69**	**0.37**	$(3.84)^{*}$

Y_{4i} = Estimated area of cotton crop in Dakahlia Governorate (in thousand feddan) in observation i. Y_{5i} = Estimated acre productivity of cotton crop in Dakahlia Governorate (in metric quintals/ feddan) in observation i. Y_{6i} = Estimated production of cotton crop in Dakahlia Governorate (in thousand metric quintals) in observation i, X represents time in years i = 1:24
** Significant at 0.01 significance level * Significant at 0.05 significance level.
Source: Results of statistical analysis of data in Table (3) using the statistical program (SPSS 20).

(3) Cotton crop production in Dakahlia Governorate:

Data in Table (3) indicate that the average cotton production in Dakahlia Governorate during the period (2000-2023) amounted to about 388.2 thousand metric quintals, representing about 15.3% of the average cotton production in Egypt.

The minimum cotton production in Dakahlia Governorate reached about 125.6 thousand metric quintals in 2015, representing about 32.4% of the average cotton production in Dakahlia Governorate during the study period, and representing about 12.3% of the cotton production in Egypt for the same year. The minimum relative importance of cotton production in Dakahlia Governorate to cotton production in Egypt reached about 8.7% in 2000.

While the maximum cotton production in Dakahlia Governorate reached about 615.2 thousand metric quintals in 2011, representing about 158.4% of the average cotton production in Dakahlia Governorate during the study period, and representing about 15.3% of the cotton production in Egypt for the same year. The maximum relative importance of cotton production in Dakahlia Governorate to cotton production in Egypt reached about 23.3% in 2021.

By studying the general time trend of the development of cotton production in Dakahlia Governorate during the period (2000-2023), Equation No. (3) Table (4) shows a general trend of a statistically significant decrease at a significance level of 5% in cotton production in Dakahlia Governorate estimated at 29.85 thousand metric quintals during the indicated period. With an annual decrease rate of about 7.69% of the annual average of cotton production in Dakahlia Governorate, which amounted to about 388.2 thousand metric quintals during the study period, The coefficient of determination also shows that about 37% of the changes in cotton production in Dakahlia Governorate are attributed to variables whose effect reflects the time factor.

Second: Studying the most important items of the costs per feddan for producing cotton crops in the study sample in Dakahlia Governorate for the 2024 season.

(1) The physical average of labor and production requirements per feddan for cotton crops in Dakahlia Governorate:

By studying the data included in Table No. (5) For the physical average of labor and production requirements per feddan for the cotton crop in the study districts of Sherbin and Belqas in Dakahlia Governorate for the 2024 season, it found that the average farm capacity per acre amounted to about 1.44 and 1.55 acres, respectively. While the average human labor was about 78.1, and 88.63 man/day respectively. While the average mechanical labor was about 28.9 and 43.04 mechanical hours respectively. While the average seed quantity was about 24.76, and 25.3 kg respectively. The average use of phosphate fertilizers was about 22.99, and 23.62 phosphate units respectively. While the average use of potassium fertilizers was about 21.47, 22.13 potassium units. While the average use of nitrogen fertilizers was about 50.86, and 54.3 nitrogen units respectively. The average use of foliar fertilizers was about 10.86, and 9.17 liters of foliar fertilizer respectively. The average use of pesticides was 5.45, and 7.2 liters of pesticide respectively.

Table (5) The physical average of labor and production requirements per feddan for the cotton crop in Dakahlia Governorate, 2024 season.

Production requirements	units	Sherbin district	Belqas district	T – Test
Farm Capacity	feddan	1.44	1.55	0.53
Human Labor	man/day	78.1	88.63	(3.88)**
Mechanized Labor	hour	28.9	43.04	(18.03)**
Seeds	kg	24.76	25.30	(2.24)*
Phosphate Fertilizer	unit	22.99	23.62	(3.10)**
Potassium Fertilizer	unit	21.47	22.13	1.63
Nitrogen Fertilizer	unit	50.86	54.30	(4.52)**
Foliar Fertilizer	lite	10.86	9.17	(5.94)**
Pesticides	lite	5.45	7.20	1.82

Source: Results of field study data analysis using (SPSS 20) statistical analysis program.

The T-test analysis shows that there are significant differences between the physical averages of human and mechanical labor and production requirements for each of the seeds, phosphate, nitrogen, and foliar fertilizers, while there are no significant differences between the physical averages of each of the potassium fertilizer and pesticides between the study districts of Sherbin and Belqas in Dakahlia Governorate.

(2) Production costs per feddan for labor and production requirements for cotton crops in Dakahlia Governorate:

By studying the data included in Table No. (6) for the production costs per feddan for human and mechanical labor and production requirements for the cotton crop in Dakahlia Governorate for the 2024 season. It became clear that the total variable costs for the cotton crop are higher in Sherbin district, where they amounted to about 31.3 thousand pounds, compared to their counterparts in Belqas district, which amounted to about 28.7 thousand pounds. It also showed that the cost of production requirements is higher in Sherbin district, where it reached about 11.36 thousand pounds, representing about 36.24% of the total variable costs, compared to its counterpart in Belqas district, which amounted to about 9.88 thousand pounds, representing about 34.5% of the total variable costs. The cost of human labor in the Sherbin and Belqas districts amounted to about 15.07 and 11.9 thousand pounds, representing about 48.1 and 41.8% of the total value of variable costs, respectively. The cost of automated labor in the Sherbin and Belqas districts amounted to about 4.91 and 6.81 thousand pounds, representing about 15.7 and 23.8% of the total value of variable costs, respectively. By studying the items of production requirements costs, it found that the cost of seeds used in the Sherbin and Belqas districts amounted to about 1.55 and 1.58 thousand pounds, representing about 4.95% and 5.5% of the total value of variable costs, respectively. While the cost of phosphate fertilizer amounted to about 741 and 761 pounds, representing about 2.37%, and 2.66% of the total value of variable costs, respectively. The cost of potassium fertilizer amounted to about 2.15, and 2.21 thousand pounds, representing about 6.85%, and 7.7% of the total value of variable costs, respectively. The cost of nitrogen fertilizer amounted to about 1.7 and 1.81 thousand pounds, representing about 5.41%, and 6.31% of the total value of variable costs, respectively. The cost of foliar fertilizer amounted to about 2.82 and 0.97 thousand pounds, representing about 9.0%, and 3.39% of the total value of variable costs, respectively. The cost of pesticides amounted to about 2.41, and 2.55 thousand pounds, representing about 7.69% and 8.89% of the total value of variable costs, respectively.

The T-test analysis shows that the difference between the two districts was significant in the averages of all cost items except for the averages of potassium fertilizer and pesticide costs.

Table (6) Production costs feddan acre for labor and production requirements for the cotton crop in .Dakahlia Governorate, 2024 season.

Production costs		Sherbin district		Belqas district		T – Test
		Cost in pounds	%of variable costs	Cost in pounds	%of variable costs	
Farm Capacity		15070.54	48.08	11965.00	41.75	(9.42)**
Human Labor		4914.414	15.68	6808.67	23.76	(3.30)**
The cost of production requirements	Seeds	1547.514	4.94	1580.98	5.52	(2.24)*
	Phosphate Fertilizer	741.73	2.37	761.84	2.66	(3.10)**
	Potassium Fertilizer	2147.03	6.85	2212.87	7.72	1.63
	Nitrogen Fertilizer	1695.21	5.41	1809.87	6.31	(4.52)**
	Foliar Fertilizer	2819.8	9.00	972.67	3.39	(21.07)**
	Pesticides	2410.08	7.69	2548.87	8.89	1.38
Total cost of production requirements		11361.3	36.24	9887.10	34.50	(9.19)**
Variable Costs		31346.32		28660.77		(4.23)**

Source: Results of field study data analysis using (SPSS 20) statistical analysis program.

From the above, it is clear that variable costs are lower in the Belqas district compared to the Sherbin district because of the lower costs of both human labor and production requirements, the most important of which is the cost of foliar fertilizer. It is also clear that human labor represents the largest proportion of the value of variable costs, which reflects the importance of the human labor element in cotton production; given that, it is a labor-intensive crop.

Third: Study of the productive and economic efficiency of the cotton crop in the study sample in Dakahlia Governorate, season 2024

1. **The most important actual and estimated productivity and economic measures per acre for the cotton crop in Dakahlia Governorate for the 2024 season**
   a) **The most important actual productivity and economic measures per feddan for the cotton crop in Dakahlia Governorate, 2024 season**

By studying the data included in Table No. (7) For the economic and productivity measures per feddan of cotton crop in Dakahlia Governorate for the 2024 season, it found that the total return per feddan in Belqas district was higher than in Sherbin district, where it amounted to about 39.24 and 34.08 thousand pounds, respectively. This is primarily due to the higher average productivity per feddan in the Belqas district than in the Sherbin district, which reached about 3.27 and 2.84 quintals, respectively. In addition, total costs in the Belqas district were lower than in the Sherbin district, which amounted to approximately 38.64 and 41.32 thousand pounds, respectively. This is primarily due to the lower variable costs in the Belqas district compared to those in the Sherbin district, which amounted to approximately 28.66 and 31.35 thousand pounds, respectively. This led to an increase in the return over variable costs in Belqas district compared to Sherbin district, where it amounted to approximately 10.58 and 2.73 thousand pounds, respectively. It was also shown that the net return, profitability, and return per pound invested per feddan in Belqas district amounted to about 598 pounds, 1.52%, and 0.02 pounds compared to Sherbin district, where it achieved losses estimated at -7.23 thousand pounds, -21.23% and -0.18 pounds respectively. The return/cost ratio in the Belqas district reached about 1.02 pounds, compared to in the Sherbin district, which amounted to about 0.82 pounds. The added value in the Belqas and Sherbin districts amounted to about 29.35 and 22.72 thousand pounds, respectively, while the cost of producing a quintal in the Belqas and Sherbin districts amounted to about 11.82 and 14.55 thousand pounds, respectively. **The T-test analysis shows that the differences between the two districts were found to be significant for all economic and productivity measures.**

Table No. (7) Actual and estimated economic and productivity measures per feddan of cotton crop in Dakahlia Governorate, 2024 season.

Variables		Actual			Estimated total sample	T - Test
		Sherbin district	Belqas district	Total sample		
1	**productivity**	2.84	3.27	3.10	3.10	(2.29)*
2	**Total return**	34080	39240	12000	17301.75	(2.29)*
3	**Variable costs**	31346.32	28660.77	37180.58	53610.64	(4.23)**
4	**Fixed costs**	9969.86	9981.09	29734.99	29734.99	0.67
5	**Total costs**	41316.18	38641.86	9976.60	9976.60	(4.20)**
6	**return over variable costs (benefit property rights)**	2733.68	10579.23	39711.59	39711.59	(3.86)**
7	**net return**	-7236.18	598.14	7445.59	23875.66	(3.97)**
8	**Profitability (Producer Profit Margin Percentage) %**	-21.23	1.52	-2531.01	13899.06	(3.32)**
9	**return/cost ratio**	0.82	1.02	-6.81	25.93	(3.66)**
10	**Added value**	22718.64	29352.90	0.94	1.35	(3.06)**
11	**Return per pound invested**	-0.18	0.02	37146.08	43133.84	(3.66)**
12	**Costs of production per quintal**	14547.95	11817.08	-0.06	0.35	(3.31)**

Return over variable costs = Total return - Variable costs.
Profitability (Producer Profit Margin Percentage) % = (net return / Total return) × 100.
Benefit = Total return - Total cost of production requirements.
Return per pound invested = net return / Total costs.
Farm price = $\frac{\text{Production costs + 35\% of production costs – Secondary Return}}{\text{feddan productivity}}$

** Significant at 0.01 significance level * Significant at 0.05 significance level.

Source: Results of field study data analysis using (SPSS 20) statistical analysis program.

From the above, it is clear that the productivity per feddan this year in the two study districts is low compared to the average productivity in Dakahlia Governorate the previous year. This is due to many reasons, including production reasons related to the spread of some fungal and insect diseases and the weakness of some varieties, in addition to the negative effects of climate change, in addition to marketing problems, and lower prices compared to the previous year. These problems will presented in detail later, which increased in the cost of producing a quintal and a decrease in production returns for all economic standards.

b) The most important production and economic measures estimated per feddan for the cotton crop in Dakahlia Governorate, 2024 season

The estimated productivity parameters and economic parameters per feddan of the cotton crop in Dakahlia Governorate were calculated using the farm price estimated according to the production cost criterion. This price must cover some of these costs and allow for a profitable net return for the farmer. The farm prices are

estimated according to the cost criterion in more than one way, depending on the value added as net profit for the farmer, including the modified production costs method (by adding 35% of the total costs as net profit for the farmer): where

$$\text{The farm price} = \frac{\text{production costs} + 35\% \text{ of production costs} - \text{secondary product return}}{\text{Feddan productivity}} \quad (4)$$

The data in Table (7) show that the production costs of a feddan of cotton crop in the total sample of the study in Dakahlia Governorate amounted to about 39711.6 pounds/feddan, and thus 35% of the production costs amounted to about 13899.1 pounds/feddan. The average productivity of a feddan of cotton crop in the total sample in Dakahlia Governorate amounted to about 3.1 quintals/feddan. According to the farmers of the study sample, there is no return for the secondary product as it is disposed of by burning it on the agricultural land because it requires intensive labor, and thus the cost of removing it from the land is higher than the return from it. Therefore, the estimated farm price for the cotton crop for the total sample amounted to about 17,301.75 pounds/quintal, which is higher than the guaranteed price set for the quintal of the 2024 cotton crop, which amounted to about 12,000 pounds/quintal, by about 5,301.75 pounds/quintal. According to the estimated farm price from the study sample in Dakahlia Governorate, the total estimated return per feddan amounted to about 53.6 thousand EGP/feddan, which is more than the total actual return of 37.18 thousand EGP, about 16.4 thousand EGP, representing about 44.2%. It also showed that the net return per feddan, profitability, and return per pound invested for the total estimated sample of Dakahlia Governorate amounted to about 13.9 thousand pounds, 25.93%, 0.35 pounds compared to their actual counterparts for the total Dakahlia Governorate, where they achieved losses estimated at -2.53 thousand pounds, -6.81%, -0.06 pounds respectively. The estimated return/cost ratio for the total Dakahlia Governorate amounted to about 1.35 pounds compared to its actual counterparts amounting to about 0.94 pounds, and the estimated and actual added value for the total Dakahlia Governorate amounted to about 43.13 and 37.15 thousand pounds respectively.

From the above, it is clear that the guaranteed price set by the state for the cotton crop is not based on real, realistic data on production costs and productivity per feddan, which exposes farmers to losses and reluctance to grow cotton again, and thus a decline in the areas planted with cotton and a decrease in local production.

2. Study of the production efficiency of production resources used to produce cotton crops in Dakahlia Governorate:

By studying the data contained in Table No. (8) To estimate the production functions of the cotton crop in the study sample in Dakahlia Governorate for the 2024 season, several attempts were made to statistically estimate the production functions in different mathematical forms, where it was found that the best of these forms is the double logarithmic form to express the relationship between production and production resources. The study of the production function aims to identify the productive and economic efficiency of the resources used and the possibility of achieving the greatest possible amount of production with a certain amount of resources or achieving a certain amount of production with the least possible amount of resources.

Table (8) Cotton crop production functions in the study sample in Dakahlia Governorate, 2024 season.

series	districts	The equations	Adjusted R^2	F
1	Sherbin district	$LNQ_1=0.4+0.5LNX_1-3.3LNX_2+1.4LNX_3+1.3LNX_4+1.2LNX_5$ 0.873 (2.29)* (-5.402)** (2.14)* (2.33)* (2.33)*	0.98	(342.82)**
2	Belqas district	$LNQ_2=-2.1+1.2\ LNX_2+0.6LNX_4+0.1LNX_5-0.5-LNX_6$ (-6.87)** (3.80)** (3.89)** (2.26)* (-2.55)*	0.96	(333.41)**

** Significant at 0.01 significance level, * Significant at 0.05 significance level, LN denotes the logarithm LN10.

Where:

Q_1 = estimated quantity of cotton crop in quintals in the study sample in observation i in Sherbin district, i=1, 2, 3, ..., 50.

Q_2 = estimated quantity of cotton crop in quintals in the study sample in observation i in Belqas district, i=1, 2, 3, ..., 70.

X_1 = Quantity of human labor (man/day), X_2 = Quantity of seeds used (in kg), X_3 = Quantity of phosphate fertilizer (in unit) = X_4 = Quantity of foliar fertilizer (in liters), X_5 = Quantity of pesticides (in liters), X_6 = Quantity of mechanical labor (in hour) in observation i.

Source: Results of field study data analysis using (SPSS 20) statistical analysis program.

From equation No (1) of Table (8) of the production function of Sherbin district that there is a direct and statistically significant relationship between the quantity of cotton production (Q_1) in the study sample and the amount of human labor used (X_1), the amount of phosphate fertilizer (X_3), the amount of foliar fertilizer (X_4), and the amount of pesticides (X_5). An increase in the user of one of these resources by 1%, with all other factors constant, will lead to an increase in production per feddan by 0.5%, 1.4%, 1.3%, and 1.2%, respectively. **It is clear from the partial elasticity coefficient of the human labor element that it is positive and less than one,**

which means that the use of this resource is economical and used optimally, as this did in the second economic stage of production. As for phosphate fertilizer, foliar fertilizer, and pesticides, their elasticity coefficients are positive and greater than one, which means that the use of these resources is uneconomical and is not used optimally, as this is done in the first stage of production. While it is clear that there is an inverse and statistically significant relationship between production and the quantity of seeds (X_2), and that increasing the quantity of seeds used by 1% with all other factors constant will lead to a decrease in production by -3.3%. **The partial elasticity coefficient is negative, which means that there is an overuse of the quantity of seeds. This occurs in the third production stage of production and this may be due primarily to weak germination and the absence of a large percentage of seeds, which forces farmers to use additional seeds and patch some of the missing holes that did not germinate.**

The adjusted coefficient of determination indicates that 98% of the changes that occur in production are due to changes that occur in the quantity used of the explanatory variables in the production function at Sherbin district and that 2% of the remaining changes are due to other unstudied variables. The calculated value of (F) also indicates the significance of the model at a significance level of 0.01.

The total elasticity of production in the Sherbin district reached about 1.1, and since it is positive and greater than one, it reflects the stage of increasing return of scale, and the increase in production resources, whose significance is proved by the aforementioned function, combined by 1%, will lead to an increase in production by about 1.1%. **This means that the cotton farmers in the study sample in Sherbin district produce in the first stage of the law of diminishing returns and that the farmers have not yet reached the optimal production and had the opportunity to reach this level of production if the available resources are optimally exploited. Thus, it becomes clear that the production efficiency of the production resources used to produce cotton in the Sherbin district is low.**

As shown by equation No. (2) Table (8) of the production function in Belqas district, there is a direct and statistically significant relationship between the quantity of cotton production (Q_2) in the study sample and the quantity of seeds (X_2), foliar fertilizer (X_4), and pesticides (X_5). An increase in the user of one of these resources by 1%, with all other factors constant, will lead to an increase in production by 1.2%, 0.6%, and 0.1%, respectively. **It is clear from studying the partial elasticity coefficients of the quantity of seeds that they are positive and greater than one, which means that the production efficiency of the seed element is low and that its use is uneconomical and has not been used optimally, as this is done in the first production stage. While the partial elasticity coefficients for the foliar fertilizer and pesticides are positive and less than one, this means that the production efficiency of these two resources is high and that they are used in the second economic production stage.** While it is clear that there is an inverse and statistically significant relationship between production and the amount of automated labor (X_6), increasing the amount of automated labor by 1%, with all other factors constant, will lead to a decrease in production by -0.5%. **Since the partial elasticity coefficient is negative, it means that there is an overuse of the amount of automated labor, as this occurs in the third production stage. This may be due to the increase in the number of hours of use of the tractor because of the great attention paid to preparing the land and the increase in the number of hours of use of spray motors because of the attention paid to the use of foliar fertilizers and pesticides.**

The adjusted coefficient of determination indicates that 96% of the changes in production are due to changes in the quantity used of the explanatory variables in the production function at Belqas district and that 4% of the remaining changes are due to other unstudied variables. The calculated value of (F) also indicates the significance of the model at a significance level of 0.01.

The total elasticity of production in the Belqas district reached about 1.4. Since it is positive and greater than one, it reflects the stage of increasing return of scale. The increase in productive resources, whose significance was proven by the aforementioned function, combined with 1% will lead to an increase in production by about 1.4%. **This means that the cotton farmers in the study sample in the Belqas district produce in the first stage of the law of diminishing returns. Farmers have not yet reached optimal production, and they had the opportunity to reach this level of production if the available resources were optimally exploited.**

3. Study of the economic efficiency of production resources used to produce cotton crops in Dakahlia Governorate:

The economic efficiency of a resource to produce a certain crop is estimated when the marginal product value of this resource equals its price, as shown by the following equation: **The marginal product value of the resource ÷ the unit price of the resource = one**

When the equation's result is one, the resource used is at its maximum economic efficiency. If the result of the equation is greater than one, this indicates that the economic efficiency limit has not been reached, and in this case, it is recommended that the user of this resource should increase it. If the result of the equation is less than one, this means that there is waste in the use of the resource, and it is recommended that the user of this resource should reduce it.

The data in Table No. (9) Indicate an estimate of the economic efficiency of the resources used in producing the cotton crop in the study sample in Dakahlia Governorate. As it was shown that the average productivity of the production elements used in the Sherbin district for each of human labor, seeds, phosphate fertilizer, foliar fertilizer, and pesticides amounted to about 0.04, 0.11, 0.12, 0.26, and 0.52 quintals. While the marginal product of the same elements used was about 0.02, -38, 0.17, 0.34, and 0.63 respectively. By comparing the marginal product of phosphate fertilizer, foliar fertilizer, and pesticides, which have proven to be significant, with their average productivity, we find that the marginal product represents values greater than the average productivity, which means that they are still operating in the first production stage and have not been used optimally. As for human labor, whose significance has been proven by its average productivity, we find that the marginal product represents values less than the average productivity, which means that it operates in the second economic production stage, which is used optimally. We find that the marginal product of the seed element is negative, which means that this resource is operating in the third production stage, which means that there is waste in its use. By comparing the value of the marginal product of these elements with their unit price, it became clear that the economic efficiency of these productive elements reached approximately 1.13, -72.67, 64.33, 15.71, 16.97, and all of these values are greater than one. **This means that the economic efficiency of using these resources has decreased and has not reached the level of economic efficiency. It is recommended to increase the quantities used in the production process until the optimal resource combination can be reached, except for the seed element, which indicates that there is waste in its use. It is recommended to reduce the amount used or study the reasons for this waste.**

Table (9) Estimation of the production and economic efficiency of the production elements used in producing the cotton crop in the study sample in Dakahlia Governorate, 2024 season

district	Production elements	Unit	productivity flexibility	Physical quantity	Productivity per feddan quintal/acre	Average output in quintals	Marginal output	Price of a quintal of cotton (pound/ quintal)	Value of marginal output (pound)	Unit price of the production element (in pounds)	Economic efficiency
Sherbin district	human labor **(X_1)**	man/ day	0.5	78.1	2.84	0.04	0.02	12000	218.18	192.96	1.13
	seeds **(X_2)**	kg	-3.3	24.76	2.84	0.11	-0.38	12000	-4542.16	62.50	-72.67
	phosphate fertilizer **(X_3)**	unit	1.4	22.99	2.84	0.12	0.17	12000	2075.34	32.26	64.33
	foliar fertilizer **(X_4)**	lite	1.3	10.86	2.84	0.26	0.34	12000	4079.56	259.65	15.71
	pesticides **(X_5)**	lite	1.2	5.45	2.84	0.52	0.63	12000	7503.85	442.22	16.97
Belqas district	seeds **(X_2)**	kg	1.2	25.3	3.27	0.13	0.16	12000	1861.19	62.49	29.78
	foliar fertilizer **(X_4)**	unit	0.6	9.17	3.27	0.36	0.21	12000	2567.50	106.07	24.21
	pesticides **(X_5)**	lite	0.1	7.2	3.27	0.45	0.05	12000	545.00	354.01	1.54
	mechanical labor **(X_6)**	hour	-0.5	43.04	3.27	0.08	-0.04	12000	-495.06	158.19	-2.88

(1) Elasticity = marginal product ÷ average product and therefore marginal product = elasticity × average product.
(2) Average product = productivity per acre ÷ average physical quantity of the production element
(3) Value of marginal product = marginal product × average price of a quintal of cotton from the product.

Source: Results of field study data analysis using (SPSS 20) statistical analysis program.

As shown in the data in Table (9), the average productivity of the production elements used in the Belqas district for each of the seeds, foliar fertilizer, pesticides, and mechanical labor amounted to about 0.13, 0.36, 0.45, and 0.08 quintals. While the marginal product of the same elements used amounted to about 0.16, 0.21, 0.04, and -

0.05 respectively. By comparing the marginal product of foliar fertilizer and pesticides, which proved significant, with their average productivity, we find that the marginal product represents values lower than the average productivity, which means that they operate in the second production stage, which is used optimally. As for the seeds, which were proven significant in their average productivity, we find that the marginal product represents values greater than the average productivity, which means that they are still working in the first production stage and have not been used optimally. We find that the marginal product of the mechanical labor element is negative, which means that this resource is working in the third production stage, which means that there is waste in its use. By comparing the value of the marginal product of these elements with their unit price, it became clear that the economic efficiency of these productive elements reached approximately 29.78, 24.21, 1.54, -2.88, and all of these values are greater than one. This means that the economic efficiency of using these resources has decreased and they have not reached the level of economic efficiency. It is recommended to increase the quantities used in the production process so that the optimal resource combination can be reached, except for the mechanical work element, which indicates that there is waste in its use. It is recommended to reduce the amount used or study the reasons for this waste.

Fourth: The relative importance of production and marketing problems facing cotton producers in the study sample in Dakahlia Governorate, 2024 season.

This part of the study will address the most important production and marketing problems facing cotton producers in the 2024 season, which were consistent with the opinions of many officials, specialists, and experts in this field when they were asked and their opinions were taken regarding cotton production and marketing this year. In addition to the state of discontent felt by cotton producers and their reluctance to cultivate it due to the low productivity and low, return from it. Experts and specialists in Egyptian cotton production explained that what happened this year is nothing but the result of the accumulation of many problems that occurred in previous years, and no radical solutions were provided for them or a clear vision and strategy was developed to advance the production and marketing of Egyptian cotton. It must be binding on all parties and guarantee both farmers and traders a profitable return and the state the advancement of Egyptian cotton the restoration of its global position and the provision of sufficient production to operate factories to revive the spinning and weaving industry once again. Therefore, it was necessary to focus on these problems, review them, explain their causes, and present proposals and solutions for how to treat them.

(1) The relative importance of production problems facing cotton producers:

The data in Table (10) indicate the relative importance of the production problems facing cotton producers in the study sample in Dakahlia Governorate for the 2024 season, arranged in descending order according to relative importance. It is clear from it that the problem of weak productivity of current varieties and their inability to withstand the negative effects of climate change ranked first with a percentage of about 85% of the total number of sample farmers. This is followed by the problem of the spread of many insect, fungal, and viral diseases and the ineffectiveness of many pesticides to combat them with a percentage of about 76.7% of the total number of sample farmers. This is followed by the problem of the lack of sufficient control over fertilizer and pesticide production companies, which allows them to manipulate and cheat with a percentage of about 71.7% of the total number of sample farmers. While the problems of the absence of the advisory role to provide advice and correct information to combat insect and fungal diseases, the absence of the role of agricultural cooperatives, and the unavailability of production requirements at the appropriate times and appropriate prices came with a percentage of about 65% of the total number of sample farmers. Then come the problems of the unavailability of trained workers at the appropriate times in addition to their high prices, and the unavailability of modern machinery and equipment for agriculture and mechanical harvesting in the penultimate place with a percentage of 62.5%, 55.8%. Then in last place comes the problem of shortage and unavailability of certified seeds, which forces farmers to resort to private ginning plants (wheels) at a rate of 45.8% of the total number of farmers in the sample. **The opinions of farmers were largely in agreement with the opinions of experts and specialists in the field of cotton production, as they confirmed that the rise in temperatures this year above normal rates caused an increase in the vegetative mass at the expense of the fruit mass. The high temperatures also caused a large fall of fruit parts reaching 70%, failure in the pollination and fertilization process, and drying of almonds. There was a large spread of the Jassid insect, fungal and viral infections, and the failure of many pesticides to combat them due to their ineffectiveness and tampering with concentrations and active ingredients. Agricultural cooperatives needed to provide guaranteed and subsidized production requirements and provide a specialized advisory body that provides correct information and field follow-up to farmers.**

(2) The relative importance of marketing problems facing cotton producers:

The state has made many attempts to develop the marketing system for the cotton crop, as it has gone through many turns and challenges, and the shortcomings of the government's performance in controlling the local market, and the shortcomings of marketing information systems about foreign cotton markets, and the low

return that the producer obtains from marketing his cotton production. Starting from the liberalization of its production and trade in 1995 until now, the state has been determining the area that must be cultivated with cotton, such that it is not less than 33% of the total agricultural area. In addition to the mandatory delivery of the crop through cooperative societies at a price determined by the state. In addition, the ban on cotton trade in domestic markets. Until the complete liberalization of the domestic cotton trade was implemented starting from the 1995 season, several ministerial decisions were issued to regulate the domestic cotton trade. In 1999, Ministerial Resolution No. 105 of 1999 was issued regarding the regulation of seed trading to prevent the mixing of varieties and to preserve Egyptian cotton varieties from deterioration. In 2001, Ministerial Resolution No. 301 of 2000 was issued to implement optional marketing of cotton in cotton production governorates. In 2002, Ministerial Resolution No. 1272 of 2002 was issued for the same purpose and the optional system for marketing of blossom cotton provided that traders establish marketing circles and collection centers according to the specified conditions, obligating them to notify the Supervisory Committee, the Domestic Cotton Trade Committee, and the Cotton Arbitration and Testing Authority. The Cotton Arbitration and Testing Authority shall provide experienced sorters to sort the cotton and estimate the purity, and sort the cotton supplied to the gins to ensure that it is not adulterated, and not to allow dealings within the country to anyone other than traders registered in the register of those engaged in cotton trade. The collection centers or marketing circles did not receive cotton supplied by non-owner producers. As a result of the decline of this system and the failure of traders to receive all the cotton produced by farmers, this gave the farmer the freedom to formulate his agricultural cycle and thus the freedom to choose the production of crops that would achieve the highest possible income. This situation resulted in the cotton crop witnessing its lowest levels in terms of the area allocated for cultivation, which negatively affected the total production and exports. The trend towards importing short- and medium-staple cotton from abroad to cover the needs of local spinning and weaving factories [(1)].

Table (10) The relative importance of production and marketing problems facing cotton producers in the study sample in Dakahlia Governorate, 2024 season.

Problem Type	Problems	Frequency	Relative Importance %
Production problems	Weak productivity of current varieties and their inability to withstand the negative effects of climate change.	102	85.00%
	The spread of many insect, fungal and viral diseases and the ineffectiveness of many pesticides to combat them.	92	76.70%
	Lack of adequate control over fertilizer and pesticide production companies, which allows them to manipulate and cheat.	86	71.70%
	Lack of guidance role to provide correct advice and information to combat insect and fungal diseases	78	65.00%
	The absence of the role of agricultural cooperatives and the unavailability of production requirements at appropriate times and prices.	78	65.00%
	The lack of trained workers at the right times, in addition to their high prices.	75	62.50%
	Lack of modern machinery and equipment for agriculture and mechanical harvesting.	67	55.80%
	The shortage and unavailability of certified seeds forces farmers to resort to private ginning plants (wheels).	55	45.80%
Marketing problems	The guaranteed prices set by the state are not based on a realistic study of the production and costs of the cotton crop.	111	92.50%
	There is manipulation within the same auction and a quasi-agreement between companies not to raise prices above a certain limit.	106	88.30%
	There is a large difference in auction prices at the beginning of the season compared to prices at the end of the season, which harms farmers.	100	83.30%
	Prices are down this year compared to last year despite higher rents and production requirements.	97	80.80%
	Delay in receiving the value of cotton from banks due to the failure of companies to pay on the required date.	95	79.20%
	After the places of collection and the inability of the farmer to withdraw his production from the complex in case of unsuitable price.	91	75.80%
	Many farmers sell their produce to traders who own private gins (wheels) due to the existence of many problems in the marketing system of auctions, which leads to problems of mixing seeds with each other and the deterioration of varieties.	72	60.00%

Source: Collected and calculated from questionnaire data for the field study sample for the 2024 season.

The data in Table (10) indicate the relative importance of the marketing problems facing cotton producers in the study sample in Dakahlia Governorate for the 2024 season, arranged in descending order of relative importance. It is clear from it that the problem of guaranteed prices set by the state that are not done through a realistic study of cotton production and costs ranked first with a percentage of about 92.5% of the total

number of farmers in the sample. It is followed in second place by the problem of manipulation within a single auction and a quasi-agreement between companies not to raise prices above a certain limit with a percentage of about 88.3% of the total number of farmers in the sample. Then comes in third place the problem of a large difference in auction prices at the beginning of the season from prices at the end of the season, which harms farmers who sold at the beginning of the season with a percentage of about 83.3% of the total number of farmers in the sample. The farmers' opinions also indicated that the problem of low prices this year compared to last year's prices, despite the increase in rents and production requirements, represents a percentage of about 80.8% of the total number of farmers in the sample. My problem was the delay in receiving the value of cotton from the banks due to the failure of companies to pay on the required date. After the collection places and the inability of the farmer to withdraw his production from the complex in case of inappropriate price, the percentage reached about 79.2% and 75.8% respectively of the total number of farmers in the sample. The problem of many farmers selling their production to traders who own private gins (wheels) due to the existence of many problems in the marketing system of auctions, which leads to problems of mixing seeds and the deterioration of varieties, ranked last with a percentage of about 60.0% of the total number of farmers in the sample. The farmers' opinions largely agreed with the opinions of experts and specialists in the field of cotton marketing, as they stressed that the guaranteed price should be set according to realistic and real studies of production and costs that guarantee the farmer marketing his production at a fair price that achieves a profitable return. And obligating companies to immediately pay farmers' dues and setting sufficient controls within auctions that ensure competitiveness in purchasing and reaching the highest price. So that the farmer does not resort to marketing his production outside the marketing system of the General Authority for Arbitration and Cotton Testing. This causes many problems later, the most important of which is mixing seeds with private gins and the deterioration of the variety specifications of current varieties. And the necessity of setting laws and procedures that guarantee the sustainability of the cultivation and supply of Egyptian cotton varieties in quantity and quality and with the specifications of the distinctive staple for each variety. In addition, appropriate for operating the new or renovated spinning mills that the state opened this year as the first phase of three phases of the national project to develop the spinning and weaving industry, which will cost 56 billion pounds. Especially after the events and problems that occurred and faced the farmers and the cotton crop this year.

Recommendations:

1. The necessity of working to develop and produce new varieties of cotton with high productivity that can withstand climate changes and emerging insect, fungal, and viral infections, providing production requirements to agricultural cooperatives at appropriate times and appropriate prices, and activating and invigorating the agricultural extension apparatus.
2. Working on setting guaranteed prices through a realistic study of production and actual costs of the cotton crop during the production season, in a way that guarantees the farmer a profitable profit margin.
3. It is necessary to put in place adequate mechanisms and procedures within the auctions to ensure that there is no manipulation within the auction and to confront any agreement between companies not to raise prices above a certain limit and the entry of the Cotton Holding Company as a competitor within the auctions.
4. The necessity of obligating companies to pay immediately the value of the cotton that was purchased, simplifying, and completing the disbursement procedures from banks.

IV. References

1. Osama Ahmed Al-Bahansawy (PhD), Sahar Ibrahim Al-Bahaei (PhD), An Economic Study of the Factors Affecting the Stability of Egyptian Cotton Production and Trade, Egyptian Journal of Agricultural Economics, Volume (25), Issue (2), June 2015.
2. Iman Salem Al-Batran (PhD), Duaa Samir Muhammad Morsi (PhD), Estimating the demand for Egyptian cotton exports in foreign markets, Egyptian Journal of Agricultural Economics, Volume (33), Issue (1), 139-160, March 2023.
3. Hatem Mahmoud El-Senousy (PhD), An Analytical Economic Study of Cotton Crops in Sohag Governorate, Egyptian Journal of Agricultural Economics, Volume (27), Issue (3), September 2017.
4. Talat Hafez Ismail (PhD), Criteria for Determining Guarantee Prices for the Most Important Imported Grain Crops in Egypt, Journal of Agricultural Sciences, Assiut University, Volume (48), Issue (1-2), 2017.
5. Montaser Sayed Ahmed El-Serry (PhD) (and others), Economics of Cotton Production and Marketing (Case Study of Sharkia Governorate), Zagazig Journal of Agricultural Research, Faculty of Agriculture, Zagazig University, Volume (48), Issue (1), 2021.
6. Mohamed Nagi Abdel-Majeed, Economics of Egyptian Cotton Production and Foreign Trade, Master's Thesis, Department of Agricultural Economics, Faculty of Agriculture, Assiut University, 2011.
7. Mohie Zein El-Abidin Mohamed Darwish (PhD), An Analytical Economic Study of the Factors Affecting the Future of Egyptian Cotton Production, Egyptian Journal of Agricultural Economics, Volume (28), Issue (3), September 2018.

8. Dakahlia Governorate Agriculture Directorate, Statistics Department, unpublished data.
9. Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, various issues.